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BEFORE THE  
FEDERAL COMMUNICATIONS COMMISSION  
WASHINGTON, D.C. 20554

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JUN 19 1996

In the Matter of )  
 )  
Amendment of Parts 2 and 15 of the )  
Commission's Rules Regarding Spread )  
Spectrum Transmitters )

ET Docket No. 96-98

RM-8435, RM-8608, RM-8609

FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF SECRETARY

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COMMENTS OF TELETRAC LICENSE, INC.

Teletrac License, Inc. ("Teletrac") hereby submits its comments in the above-captioned proceeding.

INTRODUCTION

Teletrac is one of the nation's leading providers of location information and associated monitoring services to consumers, businesses and law enforcement agencies and holds multilateration Location Monitoring Service ("LMS") licenses to provide service in 26 cities nationwide. Teletrac is currently operating systems in Los Angeles, Chicago, Detroit, Houston, Dallas and Miami, covering a total population of 38 million. In the six cities where Teletrac's system is already operational, it has deployed over 35,000 commercial units and has 49,000 total units in service. In addition, Teletrac is in the process of building out systems pursuant to the Commission's September 1, 1996, construction deadline under authority of grandfathered LMS licenses that it holds in Atlanta, Boston, Buffalo, Cincinnati, Cleveland, Columbus, Indianapolis, Milwaukee, Minneapolis, New York, Orlando, Philadelphia, Phoenix, Pittsburgh, St. Louis, San Diego, San Francisco, Seattle, Stamford and Washington, D.C.

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Teletrac has developed a proprietary system that utilizes multilateration-based techniques accurately and effectively to determine the location of vehicles on a real-time basis. Multilateration-based techniques use terrestrial receivers to determine position, thereby avoiding "line-of-sight" problems that limit the effectiveness of satellite-based and other location technologies, especially in high-density and structurally congested urban environments. Leading law enforcement and public safety agencies such as the Los Angeles County Sheriff's Department use Teletrac's system. In addition, Teletrac's current customers include Southern California Edison, TCI Cable, Pacific Bell, Detroit Public School Transportation and the Chicago Yellow Cab Company.

**THE COMMISSION SHOULD ALLOW FREQUENCY-HOPPING OVER FEWER CHANNELS AND LESS BANDWIDTH — BUT ONLY OUTSIDE THE MULTILATERATION LMS SUB-BANDS.**

The Commission has allocated the 902-928 MHz band for use by LMS licensees. 47 C.F.R. § 90.359. Spread spectrum transmission systems also are authorized, pursuant to Part 15 of the rules, to use the 902-928 MHz band. 47 C.F.R. § 15.247. But, like all Part 15 systems, spread spectrum transmission systems must operate in a manner that does not interfere with licensed users of the frequencies that are available to them, and they must accept any interference to their service from such licensed users.

One way by which spread spectrum systems seek to avoid interference while sharing spectrum with other users is to employ "frequency hopping." As the Commission's Notice of Proposed Rule Making ("Notice") explains, "[f]requency hopping systems spread their energy by changing, or 'hopping,' the center frequency of the transmission in accordance with a

pseudorandomly generated list of channels.”<sup>1</sup> As a result, the average power density of the signal at each employed frequency is much lower than would be the case if the systems each used a single center frequency. This lower density diminishes potential interference *to* other users. The use of frequency hopping also diminishes potential interference *from* other users by relying on the fact that not all of the hopping channels will be occupied by another transmitter at the same time.<sup>2</sup>

The Commission has established rules that require hopping among a sufficiently large number of frequencies (50) at sufficiently low power to reduce the risk of potential interference among Part 15 users and between Part 15 users and any licensed users with whom they may share spectrum.<sup>3</sup> Indeed, when the Commission allocated the 902-928 MHz band to LMS systems in 1995, it determined that so long as Part 15 spread spectrum users operated pursuant to the established requirements, they would be *presumed* not to be interfering with LMS systems.<sup>4</sup>

The existing rules do not, however, completely eliminate the risk that spread spectrum systems will either cause or suffer interference in the 902-928 MHz band. Forced to hop among at least 50 frequencies, these systems must inevitably share frequencies with other users — and as more licensed and unlicensed users begin operating in this band, the risk

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<sup>1</sup>/ Notice of Proposed Rule Making (“Notice”), ¶ 4.

<sup>2</sup>/ Statement of Mario Proietti, Executive Vice President, TechnoCom Corp. (attached to these comments) (“Proietti Statement”) ¶ 2.

<sup>3</sup>/ See Proietti Statement, ¶ 3.

<sup>4</sup>/ See *Amendment of Part 90 of the Commission’s Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems*, Report and Order, PR Docket No. 93-61, 10 FCC Rcd 4695, 4715 (1995) (“LMS Order”); 47 C.F.R. § 90.361.

of overlapping use and interference will increase. To reduce this risk, the Commission, at the behest of SpectraLink Corporation, has proposed that the rules be amended to permit frequency hopping spread spectrum users to hop among a smaller number of frequencies – specifically, 25 — concentrated on as little as 6.25 MHz of spectrum, at a somewhat reduced power level. This would enable such users to avoid altogether certain frequencies in the 902-928 MHz band that are used by multilateration LMS licensees, thereby reducing the likelihood of interference.<sup>5/</sup>

This is a good idea, but only if the spread spectrum users do, in fact, avoid the frequencies used by co-located multilateration LMS licensees. While it would be possible, under the proposed rule, for spread spectrum users to operate completely outside the multilateration LMS sub-bands, it would also be possible for such users to “hop” frequencies exclusively *within* such sub-bands. If the 25 frequencies used by a frequency-hopping Part 15 user were to overlap substantially with the frequencies used by a multilateration LMS licensee, the result would be unambiguously worse than if the spread spectrum user were required to hop among 50 frequencies throughout the 902-928 MHz band.<sup>6/</sup>

Frequency hopping effectively prevents interference to other users precisely because the spread spectrum user’s signal hops in and out of the passbands of other users’ receivers. If the signal rarely or never hopped *out* of the passbands of LMS receivers, it would cause interference to LMS reception notwithstanding the reduced power level at which it was transmitted. It was precisely for this reason that the Commission refused to apply to Part 15

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<sup>5/</sup> Proietti Statement, ¶ 4.

<sup>6/</sup> *Id.*, ¶ 5.

field disturbance sensors and long range video links the same presumption of non-interference that it applies to frequency hopping in the 902-928 MHz band. Field disturbance sensors and long range video links are excluded from the presumption of non-interference because they transmit continuously on a fixed frequency. If this fixed frequency were within a multilateration LMS receiver's passband, there would be a significant and continuous risk of interference. Moreover, as the record in the Commission's LMS proceeding demonstrated, this risk would exist even at power levels that were far below both the current and proposed maximums for frequency hopping systems.<sup>7</sup>

This does not mean that the Commission should reject its proposal to allow frequency hopping over a smaller number and range of frequencies. What it does mean, however, is that the Commission should ensure that any such limited frequency hopping be implemented in a manner that *avoids* multilateration LMS frequencies rather than *encroaches* on them. To achieve this, the Commission should prohibit or restrict the use of channels in the multilateration LMS sub-bands by spread spectrum users that opt to hop among fewer than 50 frequencies. In no circumstances should more than half of the channels utilized by the frequency hopping system be within the spectrum designated for multilateration LMS

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<sup>7/</sup> *Id.*, ¶ 6. See *LMS Consensus Position on Part 15 Interference*, dated June 22, 1994, *attached to* Letter from AirTouch Teletrac, MobileVision, L.P., Pinpoint Communications, Inc., and Uniplex, to Ralph Haller, Chief, Private Radio Bureau, Federal Communications Commission, dated June 23, 1994 ("*LMS Consensus Interference Study*"); see also G.K. Smith, *Further Analysis of Interference of Part 15 Devices and LMS Wideband Systems; Probability of Interference*, prepared on behalf of MobileVision, L.P., dated June 22, 1994, *attached to* Letter from AirTouch Teletrac, MobileVision, L.P., Pinpoint Communications, Inc., and Uniplex, to Ralph Haller, Chief, Private Radio Bureau, Federal Communications Commission, dated June 23, 1994 ("*MobileVision Further LMS Interference Study*").

operation.<sup>8/</sup> Enabling spread spectrum users to avoid multilateration LMS frequencies and thereby reduce the risk of interference is precisely the point of allowing frequency-hopping among fewer channels. Consequently, the proponents of the proposed rule would likely restrict their use of such frequencies even without being required to do so.<sup>9/</sup> This requirement is necessary, however, to prevent those Part 15 users that are less concerned with interference from carelessly using frequency hopping in a manner that interferes with LMS operations.

In any event, the Commission should clarify that while spread spectrum users that comply with the *current* frequency-hopping rules and requirements (*i.e.*, users that hop among at least 50 frequencies) will continue to be presumed not to interfere with licensed users, that presumption will *not* apply to users that opt, under any revised rules, to use fewer than 50 frequencies and to use hopping channels in the multilateration LMS sub-bands. If such users are permitted to use *any* frequencies in the multilateration LMS sub-bands, LMS operators and other licensed users of the 902-928 MHz band should be permitted to show that the spread spectrum users are, in fact, causing interference -- and, upon such showings, the Part 15 users should be required to eliminate such interference.

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<sup>8/</sup> This is consistent with current rules, under which a fifty-channel frequency hopping system using 500 KHz channels would have approximately half of its occupied bandwidth within the LMS sub-bands.

<sup>9/</sup> Indeed, in its petition for rulemaking, SpectraLink specifically proposed that frequency hopping spread spectrum devices "be permitted to use non-contiguous hopping frequencies to avoid the subsegments allocated exclusively to wideband multilateration AVM/LMS systems." *See* Petition for Rulemaking, RM-8609.

## CONCLUSION

For the foregoing reasons, the Commission should adopt its proposal to allow spread spectrum users in the 902-928 MHz band to hop among as few as 25 channels, provided that, as indicated in the attached proposed rule changes:

- any frequency-hopping spread spectrum users that utilize fewer than 50 channels are required to operate with no more than 50% of their total utilized bandwidth within the three sub-bands designated for multilateration LMS services; and
- the presumption of non-interference that generally applies to frequency-hopping spread spectrum users that comply with Part 15 rules shall not apply to users that hop among fewer than 50 channels and that operate in whole or in part, within one or more of the three sub-bands designated for multilateration LMS services.

Respectfully submitted,

TELETRAC LICENSE, INC.

By: 

John S. Logan  
Michael S. Schobler  
J.G. Harrington  
Peter A. Batacan

Dow, Lohnes & Albertson

A Professional Limited Liability Company

1200 New Hampshire Avenue, N.W.

Suite 800

Washington, D. C. 20037

(202) 776-2000

June 19, 1996

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**STATEMENT OF MARIO PROIETTI**

Mario Proietti hereby submits this declaration, pursuant to Section 1.16 of the Commission's rules, 47 C.F.R. § 1.16 and in support of the comments submitted by Teletrac License, Inc. ("Teletrac") in the above-captioned proceeding:

1. I am employed as the Executive Vice President at TechnoCom Corp., and have personal knowledge of the matters stated herein. At TechnoCom, I work as a systems engineering consultant to clients in the wireless communication and radiolocation services industries. I have worked as a systems engineer with the Teletrac multilateration location and monitoring service ("LMS") system for nearly 5 years as either an employee or consultant. In my capacity as a systems engineer, I am responsible for various aspects of system design, construction, technical operations and technology planning of Teletrac's multilateration LMS system.

2. Teletrac's LMS systems are authorized to operate in the 902-928 MHz band. Unlicensed Part 15 users are also authorized to operate in this band, provided that they do not cause harmful interference to licensed users. Within this band, Part 15 users may use spread spectrum transmission technologies. One such technology is "frequency hopping." As the Commission has explained, "[f]requency hopping systems spread their energy by changing, or 'hopping,' the center frequency of the transmission in accordance with a pseudorandomly generated list of channels."<sup>1</sup> As a result, the average power density of the signal at each employed frequency is much lower than would be the case if the systems used a single center frequency. This lower average power density diminishes potential interference to other users. The use of frequency hopping also diminishes potential interference from other users by relying on the fact that not all of the hopping channels will be occupied by another transmitter at the same time.

3. The Commission has established rules that, by requiring hopping among a large number of frequencies (50), spread over up to 26 MHz of spectrum at relatively low power (one watt), effectively reduce the risk of interference among Part 15 users and between Part 15 users and any licensed users with whom they may share spectrum. When the Commission finalized the rules for LMS systems in 1995, it determined that so long as Part 15 spread spectrum users operated pursuant to certain established requirements, they would be presumed not to be interfering with LMS systems.<sup>2</sup>

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<sup>1</sup>/ Notice of Proposed Rule Making ("Notice"), ¶ 4.

<sup>2</sup>/ See *Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems*, Report and Order, PR Docket No. 93-61, 10 FCC Rcd 4695, 4715 (1995) ("*LMS Order*"); 47 C.F.R. § 90.361.

4. Despite the Commission-mandated presumption of non-interference, there is a risk that spread spectrum systems will either cause or suffer interference in the 902-928 MHz band. Forced to hop among at least 50 frequencies, these systems must inevitably share frequencies with other users — and as more licensed and unlicensed users begin operating in this band, the risk of overlapping use and interference will increase. To reduce this risk, the Commission, at the behest of SpectraLink Corporation, has proposed that the rules be amended to permit frequency hopping spread spectrum users to hop among a smaller number of frequencies — specifically, 25 — concentrated on as little as 6.25 MHz of spectrum, at a somewhat reduced power level. This would enable such users to avoid altogether certain frequencies in the 902-928 MHz band that are used by multilateration LMS licensees, thereby reducing the likelihood of interference.

5. The proposed rule, however, does not specifically require or ensure that Part 15 users that choose to hop among fewer than 50 frequencies avoid frequencies used by multilateration LMS licensees. While it would be possible, under the proposed rule, for spread spectrum users to operate completely outside the multilateration LMS sub-bands, it would also be possible for such users to operate exclusively *within* such sub-bands.<sup>3/</sup> If the 25 frequencies used by a frequency-hopping Part 15 user were to overlap substantially with the

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<sup>3/</sup> The following are the sub-band pairs allocated for use by multilateration LMS licensees:

B	904.000 - 909.750 MHz	H	927.750 - 928.000 MHz
D	919.750 - 921.750 MHz	G	927.500 - 927.750 MHz
F	921.750 - 927.250 MHz	F	927.250 - 927.500 MHz

frequencies used by a multilateration LMS licensee, it is my professional opinion that the result would be unambiguously worse with respect to interference than if the spread spectrum user were required to hop among 50 frequencies throughout the 902-928 MHz band.

6. Frequency hopping effectively prevents interference to other users precisely because the spread spectrum user's signal hops in and out of the passbands of other users' receivers. If the signal rarely or never hopped *out* of the passbands of LMS receivers, it would have a higher likelihood of causing harmful interference to LMS reception notwithstanding the reduced power level at which it was transmitted. It was for this reason that the Commission refused to apply to Part 15 field disturbance sensors and long range video links the same presumption of non-interference that it applies to other Part 15 transmitters in the 902-928 MHz band.<sup>4</sup> Field disturbance sensors and long range video links are excluded from the presumption of non-interference because they transmit continuously on a fixed frequency. If this fixed frequency were within a multilateration LMS receiver's passband, there could be a significant and continuous risk of harmful interference. Likewise, this risk would exist if the frequency were not fixed but all hopping channels were within the LMS receiver passband. Moreover (as the record in the Commission's LMS rulemaking proceeding confirms), this risk would exist even at power levels that are far below both the current and proposed maximums for frequency hopping systems.<sup>5</sup>

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<sup>4</sup>/ This is the case even though field disturbance sensors and long range video links transmit at significantly lower power than that allowed for spread spectrum transmitters in this band. See 47 C.F.R. §§ 15.245, 15.247, 15.249

<sup>5</sup>/ See, e.g., *LMS Consensus Position on Part 15 Interference*, dated June 22, 1994, attached to Letter from AirTouch Teletrac, MobileVision, L.P., Pinpoint Communications, Inc., and Uniplex, to Ralph Haller, Chief, Private Radio Bureau, Federal Communications

## PROPOSED RULES CHANGES FOR FREQUENCY HOPPING SPREAD SPECTRUM

The only changes indicated are those that relate to the proposal to permit frequency hopping systems in the 902-928 MHz band to use fewer than 50 hopping frequencies.

Additions to current rules are indicated by *italics*. Deletions from current rules are indicated by ~~strike-through~~. Additions and deletions from the rules proposed in the Notice of Proposed Rulemaking are indicated by ***bold italics*** and by ~~**bold strike-through**~~, respectively.

### § 15.247      **Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.**

(a)      \* \* \*

(1)      \* \* \*

(i)      ~~Frequency~~ *For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies, ~~and~~ the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second time period and no more than 50 percent of the total bandwidth occupied by the system shall be within the three MTA sub-bands designated for multilateration location monitoring services under section 90.357(a) of this chapter.* The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz. ~~The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.~~

(ii)      \* \* \*

(2)      \* \* \*

(b)      The maximum peak output power of the intentional radiator shall not exceed 1 watt. ~~If the following:~~

(1)      \* \* \*

(2)      *For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and 0.5 watts for systems employing less than 50 hopping channels, as permitted under paragraph (a)(1)(i) of this section.*

- (3) *Except as shown below, if transmitting antennas of directional gain greater than 6 dBi are used . . .*

**§ 90.361 Interference from part 15 and Amateur operations.**

Operations authorized under parts 15 and 97 of this chapter may not cause harmful interference to LMS systems in the 902-928 MHz band.

(a) ~~These operations~~ *Operations authorized under parts 15 and 97 of this chapter* will not be considered to be causing harmful interference to a multilateration LMS system operating in one of the three MTA sub-bands (*see* § 90.357(a)) if they operate in accordance with the provisions of parts 15 or 97 of this chapter and at least one of the following conditions are met:

- (1) It is a field disturbance sensor operating under § 15.245 of this chapter and it is not operating in the 904-909.750 or 919.750-928.000 MHz sub-bands; or
- (2) It does not employ an outdoor antenna; or
- (3) If it does employ an outdoor antenna, then if:
  - (i) The directional gain of the antenna does not exceed 6 dBi, or if the directional gain of the antenna exceeds 6 dBi, it reduces its transmitter output power below 1 watt by the proportional amount that the directional gain of the antenna exceeds 6 dBi; and
  - (ii) Either:
    - (A) The antenna is 5 meters or less in height above ground;  
or
    - (B) The antenna is more than 5 meters in height above ground but less than or equal to 15 meters in height above ground and either:
      - (I) Adjusts its transmitter output power below 1 watt by  $20 \log (h/5)$  dB, where  $h$  is the height above ground of the antenna in meters; or
      - (II) Is providing the final link for communications of entities eligible under subpart B or C of this part 90.

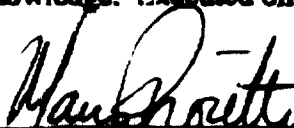
*(b) Notwithstanding subsection (a) of this section, the following standards shall apply to part 15 frequency hopping devices that utilize fewer than 50 hopping channels in accordance with Section 15.247(a)(1)(i) and otherwise operate in accordance with the provisions of part 15 of this chapter:*

*(1) Such Part 15 frequency hopping devices will not be considered to be causing harmful interference to a multilateration LMS system operating in one of the three MTA sub-bands (see § 90.357(a)) if they do not utilize spectrum in any of those sub-bands.*

*(2) Such Part 15 frequency hopping devices that operate, in whole or in part, within one or more of the three MTA sub-bands designated for multilateration LMS operation (see § 90.357(a)) shall not be subject to a presumption that they do not cause harmful interference to the multilateration LMS system(s) with which the Part 15 devices share spectrum.*

7. In sum, it is my professional opinion that the Commission's proposal could promote spectrum sharing in the 902-928 MHz band by further reducing the risk of interference between Part 15 spread spectrum transmissions and licensed LMS service — but only if, in hopping among a reduced number of frequencies, Part 15 users avoided the multilateration LMS sub-bands. Absent a requirement that such users avoid the multilateration LMS sub-bands, the proposed amendment to the rules could *increase* the risk of interference, and a presumption of *non-interference* in such circumstances would be unreasonable.

I state under penalty of perjury under the laws of the United States of America that the foregoing is true and correct to the best of my knowledge. Executed on June 19, 1996.

  
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Mario Proibetti  
Executive Vice President  
TechnoCom Corporation  
6123 County Oak Road  
Woodland Hills, CA 91367

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Commission, dated June 23, 1994 ("*LMS Consensus Interference Study*"); see also G.K. Smith, *Further Analysis of Interference of Part 15 Devices and LMS Wideband Systems; Probability of Interference*, prepared on behalf of MobileVision, L.P., dated June 22, 1994, attached to Letter from AirTouch Teletrac, MobileVision, L.P., Pinpoint Communications, Inc., and Uniplex, to Ralph Haller, Chief, Private Radio Bureau, Federal Communications Commission, dated June 23, 1994 ("*MobileVision Further LMS Interference Study*").